



UNEP Year Book 2014 emerging issues update

Plastic Debris in the Ocean



## Continuous flows of plastic to the marine environment

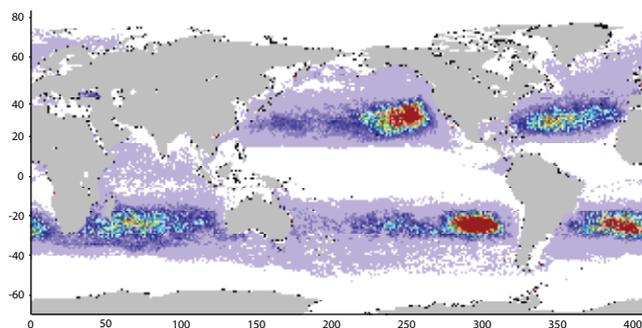
Every year large amounts of plastic debris enter the ocean from both land- and sea-based activities, such as fisheries and tourism, and poor waste management. While the total amount in the ocean is unknown, plastic is found all over the world including in the polar regions, far from its source.

Floating plastic can be transported great distances by ocean currents. Although plastic debris is most commonly observed on shorelines, it also accumulates in mid-ocean 'gyres', natural circulation features that tend to trap floating material. Some of the material sinks to the ocean floor, where it remains out of sight. Environmental damage due to plastic debris is well documented. It includes:

- Mortality or sub-lethal effects when plastic is ingested by animals such as turtles, small-toothed whales and seabirds
- Entanglement of animals such as dolphins and large whales in nylon fishing gear (like nets) and other plastic debris
- Damage to critical ecosystems such as coral reefs and smothering of sediments
- Chemical contamination of marine organisms through ingestion of small plastic particles
- Potential changes in biodiversity due to the transport of invasive species on plastic fragments

Exposure of plastic to the ocean's physical, chemical and biological processes results in fragmentation and size reduction. Plastic on the seafloor will take far longer to fragment (due to lack of UV penetration and the cold water temperatures at these depths) than plastic on beaches or in surface waters near coastal areas. Plastic is extremely persistent in the marine environment.

Media reports and the activities of non-governmental organizations (NGOs) have improved awareness of the worldwide problem of plastic debris accumulating in the ocean, often focusing on its environmental impacts. In addition, the fishing and tourism industries in many countries are economically affected by the presence of plastic debris, which can enter nets, foul propellers and litter beaches. A growing concern is the possible contamination of fish and other marine organisms that ingest plastic debris and the possible adverse impacts on ecosystems and human health.



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### Gyres

Marine debris is subject to transport by ocean currents and tends to accumulate in a limited number of subtropical convergence zones or gyres. These gyres occur in the North and South Atlantic Ocean, the North and South Pacific, and the Indian Ocean.

Read more about plastic debris in the ocean in the UNEP Year Book 2011.



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## Growing concern about microplastics

Plastic is now the most frequently reported material in encounters between debris and fish, sea birds, marine reptiles (e.g. turtles) and mammals (e.g. whales). As science progresses, more is being learned about the relationships between different types of mass-produced plastic and the organic contaminants they transport.

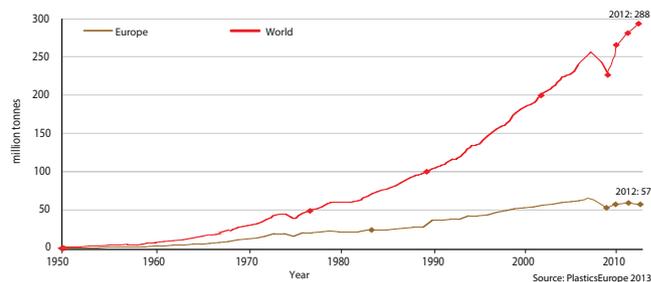
Concern is growing about the threat *microplastics* could present to marine life, including as a pathway for the transport of harmful chemicals through the food web. Ingestion of microplastics has been widely reported in a range of marine organisms including seabirds, fish, mussels, lugworms and zooplankton. Microplastics have also been identified as an emerging threat to much larger organisms, such as the endangered northern right whale, a surface-feeding baleen whale potentially exposed to microplastic ingestion as a result of its filter-feeding activity. The evidence is still insufficient, however, to quantify the nature and full extent of the effects of microplastics.

### Microplastics

Microplastics are formed when plastic items fragment and disintegrate. The rate of fragmentation is highly dependent on the environmental setting, especially temperature and the amount of UV light available. Microplastics are also manufactured for use in plastic production, for other industrial purposes such as sand blasting, or for use in consumer (e.g. personal care) products. The term 'microplastics' is widely used to describe plastic particles with an upper size limit of 5 mm in diameter, which is the size range most readily ingested by many organisms. However, microplastics in products can be as small as 0.004  $\mu\text{m}$ .

Plastic is increasingly found in the world's marine ecosystems. Every part of the ocean examined so far has revealed its presence. Microplastics were recently discovered in Arctic sea ice. Since sea ice is thinning, these small particles will likely be shed back into the water where they can be ingested by plankton, fish and other organisms.

### Growth in plastics production 1950-2012



Increasing attention is being given to the use of microplastics in a wide range of consumer goods. 'Microbeads' are found in toothpaste, douche gels and facial cleansers, among other products, sometimes replacing natural ingredients (e.g. pumice or ground seeds). These microplastics tend not to be filtered out during wastewater treatment, but to be released directly to the ocean or other water bodies such as lakes and rivers. Microplastics are also found in effluent as tiny fibres after synthetic textiles are washed.

Diverse communities of microbes have been discovered colonizing and thriving on microplastics at multiple locations in the North Atlantic described as the 'plastisphere'. One concern about the plastisphere is that it can facilitate the transport of harmful microbes, including disease-causing pathogens and harmful algal species.



## Cooperation at international, regional and national levels

The disposal of plastic at sea is outlawed under Annex V of the International Maritime Organization (IMO) MARPOL Convention, which is designed to limit the impact of shipping and other maritime activities on the environment. Regional Seas bodies have introduced controls and monitoring guidance aimed at reducing inputs of plastic at a regional level. Many countries have begun to investigate potential control measures that could reduce these inputs cost-effectively. However, legislation alone is unlikely to be effective in bringing about significant reductions in the amount of plastic debris in the ocean. That will require changes in attitudes and behaviour by everyone.

NGOs, teachers, student groups, research institutes and others continue to organize activities to address the problem of plastic debris in the ocean. These range from providing participatory research and education for young people, to gathering innovative ideas from individuals and businesses; and from beach clean-ups in which local communities take part, to policy advocacy aimed at governmental bodies. Awareness raising is often one of the main objectives of these activities. For example, artwork comprising familiar plastic objects (e.g. shoes, toothbrushes, cigarette lighters) collected from the shoreline can convey a powerful message. On a different scale, the *Plastiki*, a 18-metre catamaran made of 12,500 reclaimed plastic bottles and other recycled PET plastic and waste products, sailed from San Francisco in the United States to Sydney, Australia, to bring attention to plastic pollution of the Atlantic Ocean.

The number of scientific studies concerned with plastic in marine ecosystems has rapidly increased and research is now expanding to freshwater systems. For example, microplastics have been found in Lake Garda in Italy and the Great Lakes in North America. Several international cooperative initiatives are under way to determine the physical and chemical effects of microplastics. One is a global assessment of the sources, fate and effects of microplastics in the marine environment by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).

In some countries, monitoring and central reporting of marine debris has taken place for some time. Determining the levels of microplastics from consumer products in water bodies is a more recent activity. Increasingly, the focus is widening towards the use of citizen science and mobile technology to collect data on the environment. The European Union (EU) Marine Strategy Framework Directive describes the status of the marine environment with the help of eleven indicators, one of which is the volume of marine litter. This indicator covers both larger particles visible to the human eye and microscopic particles. Exploratory investigations are under way to determine the levels of microplastics in four of Europe's major rivers.

Industry has been actively engaged in discussions about plastic debris in the ocean and important advances have been made in plastic recycling techniques. In 2011, the global plastics industry issued a declaration committing itself to contribute in various ways to solutions for marine litter. The 'beat the microbead' campaign aims to put pressure on companies to ban use of microplastics in products and inform customers via an app. As a result, a number of personal care and retail companies have announced they will stop producing or selling products containing microplastics.

In June 2012, the Global Partnership on Marine Litter (GPML) was established with the objective of protecting human health and the environment through the reduction and management of marine litter. The GPML works as an overall coordinating multi-stakeholder forum to increase awareness of the impacts of marine litter and to enhance knowledge and best practices.



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## The key to reducing inputs of plastic debris is at the source

Every effort should be made to prevent more plastic debris entering the ocean. However, production trends, use patterns and changing demographics are expected to result in ever greater amounts of plastic debris – including microplastics. Even if it were possible to keep more plastic from entering the environment, the amount already in the ocean will continue to break down into smaller fragments and to form microplastics for hundreds of years to come.

There is wide agreement that a safer and cleaner marine environment (including protection of marine animals and of human health) is a desirable goal, but feasible ways to remove the plastic and harmful chemicals already in the environment still appear to be very limited. Nevertheless, there are many opportunities to keep more plastic items from finding their way to the ocean.

The Plastic Disclosure Project encourages businesses and institutions to measure annual plastic use or waste aggregation in their operations. Awareness campaigns continue to be needed to discourage littering and convince people to reuse or ban plastic bags, among other actions. Introducing financial incentives for re-use or recycling (e.g. introducing levies on plastic packaging) and enforcing legislation to decrease the amount of plastic debris in the environment can lead to far greater recycling and waste prevention. Proposals are frequently made to turn plastic debris into a variety of products, or to use the plastic as fuel.



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For video links please go to <http://vimeo.com/88804648>



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An important contribution is required from industry, together with universities and other research bodies, to find ways to reduce the impacts of plastic throughout its life cycle. This could include research on biodegradable resins, alternative ingredients, redesigned products, and next-generation additives that do not adversely impact the environment and human health. Apart from innovations in solid waste management, sewage treatment could be improved in order to trap smaller particles before effluent is discharged to surface water and sludge is deposited.

There is an immediate need to fill knowledge gaps and better understand the capacity of various types of plastic to sorb persistent, toxic and bioaccumulating chemicals (PBTs). Since plastic particles contaminated with these chemicals can potentially be ingested by marine organisms, the potential delivery of toxins through the food web via this mechanism needs to be further investigated and quantified if this can be shown to occur.

## Further information about plastic debris in the ocean

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